Tracking pions with CERBEROS* at the HADES spectrometer†

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In 2014 the HADES collaboration performed two successful experimental campaigns with secondary pion beams. Since the momentum distribution of the produced pion beam is very broad, two fast tracking stations were installed along the pion chicane following the pion production target to reconstruct the momentum of each individual pion (Fig.1). Both stations consist of a double sided silicon strip sensor with a large active area ($10 \times 10\ \mathrm{cm}^2$). The sensors are read out with a n-XYTER ASIC chip [1]. Due to its self-triggering architecture and local storage capability, the chip enables tracking and online beam monitoring at high rates. The TRB3 board [2] on which the trigger logic is implemented completes the readout chain and integrates the system into the Hades DAQ. All hits registered by the n-XYTER are buffered inside this board and only events correlated in time with the CTS (Central Trigger System) are send to the Event Builder.

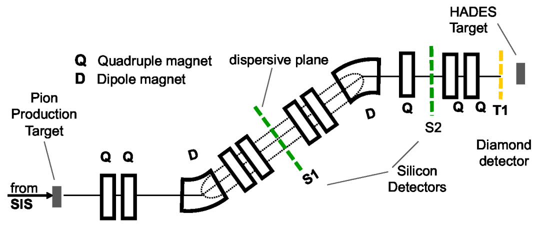

Figure 1: Schematic of the pion beam chicane. The positions of the two tracking stations are indicated in green. The first station is located at the dispersive plane.

The pion momentum is reconstructed relying on the beam optics transport calculation using the four spatial coordinate informations provided by the tracking system. A large momentum spread translates into a large x-position deviation at the dispersive plane where the first detector is located. The requested resolution of $< 0.5\%$ is two orders of magnitude better than the spread in momentum due to the beam line acceptance of about 8% and therefore allows for the exclusive analysis of reaction channels.

Prior to the actual physics production run with the secondary pion beam, the calibration of the reconstructed momentum was performed. The calibration was carried out with a proton beam with six different known momenta with respect to the central beam momentum of 2.68 GeV/c set by the accelerator. Figure 2 presents the seven momenta reconstructed on the basis of the beam optics calculation and the four spatial coordinates. All seven different values can be clearly distinguished and are in good agreement with the reference values. Since not all the momenta focus in the first detector plane the resolution of the various reconstructed momenta differ. But all resolutions are below the envisaged value of 0.5%.

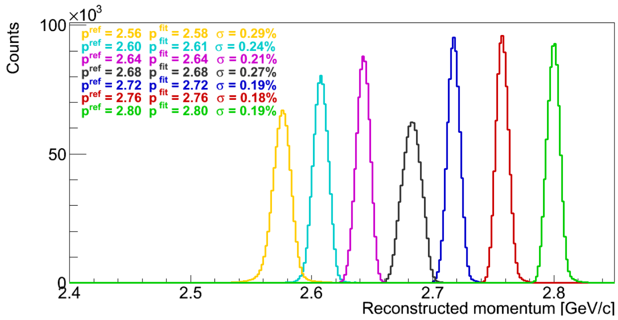

Figure 2: Reconstructed momentum calibration performed with six known momenta with respect to the central beam momentum of 2.68 GeV/c, set by the accelerator.

The momentum distribution of the pion beam is much broader due to its secondary nature and only limited by the beam line acceptance. The reconstructed spectrum of the pion momentum is shown in Fig.3. The maximal transmission occurs at the central beam momentum of 1.7 GeV/c with an asymmetric transmission for different momenta.

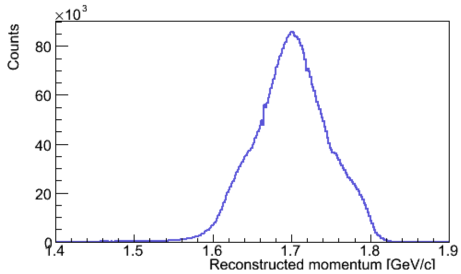

Figure 3: Reconstructed momentum distribution of the secondary pion beam at a central beam momentum of 1.7 GeV/c.

References

[1] A.Brogna et al., *Nucl. Instr. and Meth.*, A 568 (2006) 301.

[2] M. Traxler et al., *J. Instrum.*, 6(12) (2011) C12004.

* Central Beam Tracker for Pions

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